MUDDY CREEK SPECIAL WATER PROJECT

FINAL REPORT

For: CASCADE and TETON COUNTY CONSERVATION DISTRICTS

By: John Andrews
Project Coordinator

January 1985

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A special thanks is given to the Cascade and Teton County Conservation Districts, the Greenfields Irrigation District, the Muddy Creek Executive Board, and particularly, Senator Ted Neuman and Mr. Kenneth Bolland, former Area Conservationist, for their untiring efforts in the promotion of this project.

U.S. Senators John Melcher and Max Baucus, and Representative Ron Marlenee helped in the promotion of this project in Washington, D.C.. We thank them also, for their cooperation and concern.

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MUDDY CREEK SPECIAL WATER PROJECT

Muddy Creek Project Office, Cascade County Conservation District,
(USDA Building), 1211 Northwest Bypass, Great Falls, Montana. (406) 727-3603
Mailing Address: P.O. Box 5051, Great Falls MT 59403-5051

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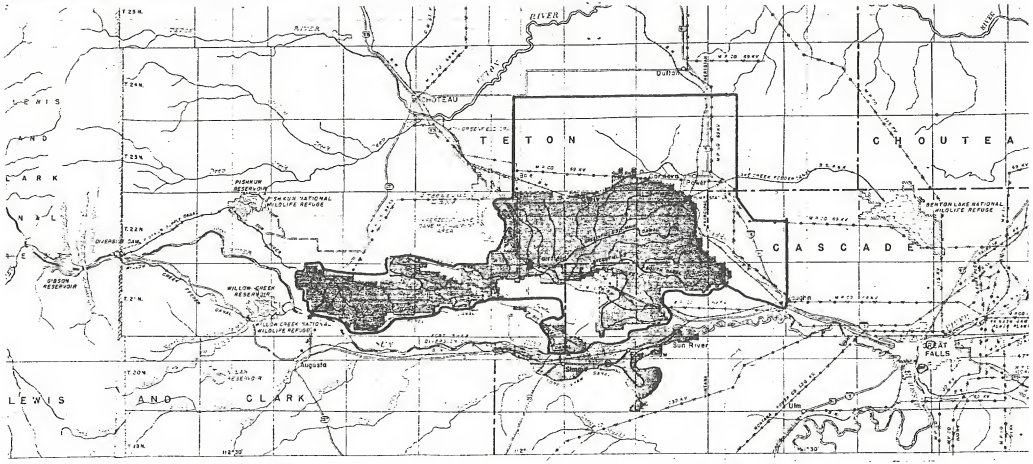

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Muddy Creek
Special Project

irrigated lands

This is the stream reach of worst erosion and bank slumping. This area is two miles above Vaughn and is characterized by deep alluvial saline soils, verticle banks, and drastic changes in water levels. (Photo--courtesy of SCS, 1983).

January 15, 1985

MUDDY CREEK SPECIAL WATER PROJECT
REPORT

Muddy Creek: Problem Identification and Project Initiation

Muddy Creek is a tributary of the Sun River, which joins the Missouri River at Great Falls, Montana. The Creek has its headwaters north of Fairfield and flows for 40 miles to the southeast where it empties into the Sun River, 10 miles northwest of Great Falls. It drains approximately 314 square miles of agricultural land. Major changes in land use in the 1920's, from dryland farming and rangeland use to irrigated cropland, have drastically augmented Muddy Creek's flow. The Fairfield Bench (Greenfields Irrigation District) in Teton County, adjacent to and west of the Creek, now supports 50,000 irrigated acres. Irrigation return flows, derived from water diverted and stored in Pishkun Reservoir some 30 miles to the west, have increased the Creek's flow ten-fold. The original unaltered flow of 10,000 acre-feet is now recorded at approximately 100,000 acre-feet yearly. This has caused extensive erosion of the fine-grained alluvial bank and bed materials of Muddy Creek and transports some 200,000 tons of sediment yearly into the Sun River.

This massive sediment load is derived from large-scale bank slumping and streambed erosion. Several acres of farmland adjacent to the Creek are lost yearly to drastic changes in stream volumes. Approximately 80 percent of the Sun River's sediment comes from Muddy Creek, although it makes-up only 15 percent of its watershed. This sediment has severely impacted the fishery and recreational values of the Sun River, and has increased flood damage to the Great Falls Sun River area. The Black Eagle Dam just below the Sun-Missouri Rivers' confluence is silting in; primarily from Muddy Creek sediment.

In 1977, the Montana Department of Health and Environmental Sciences developed a Statewide "208" Water Quality Management Plan. A public workshop was held in Great Falls in December to solicit concerns about significant water quality problems. The major topic of concern was Muddy Creek, and its sediment affect on the Sun River. In the Draft Statewide 208 Report, the paragraphs relating to Muddy Creek were as follows:

Clearly, the major problem of concern is the high sediment load in the lower Sun River caused by irrigation returns and erosion of Muddy Creek. Participants view the problem as correctable within certain limitations. Both recreational water users and agriculturalists see the need to correct the problem, but have expressed considerable disappointment in the "no follow-through action" by past government studies.

Muddy Creek will be the yardstick for which local citizenry of this area measure the success of the 208 program. It represents a local problem of significant impact and one which can be corrected within certain limitations. Past efforts have failed because the problem has not had sufficient priority within the Bureau of Reclamation to warrant proper staff study or funding for planning and construction.

In March of 1978, the Cascade County Conservation District completed an inventory of their four watershed areas and identified Muddy Creek as a serious sediment problem. In February of 1979, a County Rural Development (CRD) Committee meeting was held to respond to an Agricultural Conservation Program application deadline through the Agricultural Stabilization and Conservation Service (ASCS). This was for Special Water Quality Projects. Members representing the Cooperative Extension Service (CES), Soil Conservation Service (SCS), Farmers Home Administration (FmHA), ASCS, Greenfields Irrigation District, Montana Department of Health and Environmental Sciences (DHES), and Montana Fish and Game (now titled, Montana Fish, Wildlife and Parks, FWP) were present. With the help of these agencies, an application for the Muddy Creek drainage was prepared and submitted before a February 2nd deadline.

In February 1979, a special meeting of the Muddy Creek area landowners, U.S. Soil Conservation Service, and Bureau of Reclamation personnel was held in Power, Montana. A local organization, The Muddy Creek Landowners Association, was formed that was composed of all those property owners adjacent to the Creek. Ted Neuman was elected as chairman, Joyce Wohlgemuth, vice-chairman, and Charles Penwell, secretary.

As a result of this interest, a Muddy Creek Task Force was organized in July 1979 by the Cascade and Teton County Conservation Districts. Those involved in this organization were: the Soil Conservation Service (SCS); Agricultural Stabilization and Conservation Service (ASCS); Environmental Protection Agency (EPA); Bureau of Reclamation (BR); U.S. Army Corps of Engineers (CE); Muddy Creek Landowners Association; Montana Departments of

Health and Environmental Sciences (DHES), Fish, Wildlife and Parks (FWP), and Natural Resources and Conservation (DNRC); Cooperative Extension Service (CES); Greenfields Irrigation District (GID); and the Cascade and Teton County Conservation Districts.

The Districts hired Systems Technology, Incorporated of Helena, Montana to complete a report compiling relevant Muddy Creek data up to that time, and provide recommended solutions to the erosion problem. These solutions were:

1. On-Farm Management - of improved water and stream corridor management, and increased ASCS cost-sharing and SCS technical assistance. This included more efficient water use systems, stream riprap and minimum use streambank corridors.

2. Surplus Canal Water Diversion - excess canal water could be diverted into Freezeout Lake as a surge system.

3. Muddy Creek Stabilization - using proven erosion control measures such as, riparian vegetation protection, tree plantings, riprap, and rock drops.

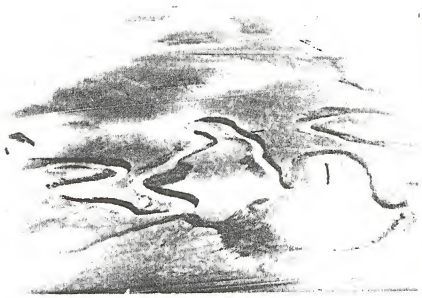
4. Interceptor Canal - to parallel the Creek and intercept Fairfield Bench irrigation return flows. Such a canal would be constructed on the west side of Muddy Creek and be 14 miles long.

5. Greenfields Irrigation District - modifications to the present water delivery system in automating reservoir water releases and measuring each field delivery as well as hydroelectric generation on canals.

6. Educational Program - involving local residents and farmers and promoting participation of federal and state agencies.

7. Funding Search - pursuing state and federal funding sources for both on-farm and stream protection measures.

In addition, a tour of the Muddy Creek watershed was arranged by U.S. Senator Max Baucus. Those participating in the February 1980 tour were: Dr. David Carter (USDA), Professor Gaylord Skogerboe, (Colorado State University), and Dr. Arthur Hornsby (EPA). The comments and recommendations of Doctors Carter and Hornsby are summarized as follows:



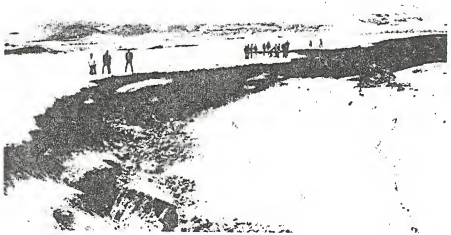
This photo shows the most graphic area of Muddy Creek's erosion. The meander has now cut through, isolating the land area in the left center of the photograph. 1980.

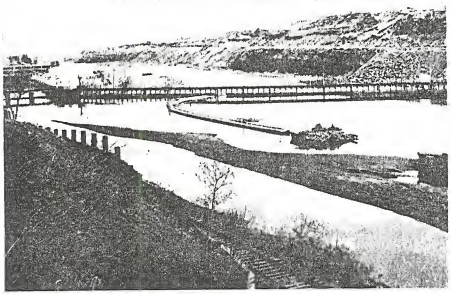
Saline soils are one of the contributing factors to slumping. High flows saturate the banks dissolving the salt and withdrawing support. Banks here are about 40 feet high.

Massive slumping on Spring Coulee drainway. Numerous seeps on valley sides are a result of groundwater flows at bedrock contact zone and saturation of lower soil areas.

Sun River-Muddy Creek confluence. Drastic color change and silt bar in Sun River is due to fine silt transported from Muddy Creek's lower 12 miles.

An example of massive slumping on Muddy Creek above Mr. Joyce Wohlgemuth's farm. Streambank spring aggravated this. Within two years, this will no longer be visible. 1982.





This is a silt bar in the Missouri River just above Black Eagle Dam, (Great Falls). It is calculated that most of this came from the Muddy Creek drainage. 1980.

1. There is no storage or surge capacity built into the main supply canal system and structures are needed to solve this. This, as mentioned, could include diversions into Freezeout Lake, and dams on Muddy Creek.

2. The Cooperative Extension Service (CES) and Soil Conservation Service (SCS) should provide farmers with assistance to reduce percolation and surface water losses. This should include:

   a. A hydrologic water budget for the irrigated area and monitoring of farm field water application, use and losses.

   b. Alternative surface irrigation systems, such as promoting the use of sprinkler and automated surface systems.

   c. Irrigation Scheduling to be implemented on a variety of fields and monitored for efficiency.

3. There needs to be a water quality assessment of domestic wells and the Creek.

4. Hydro-electric generation should be explored using the canal systems where sufficient drop occurs.

5. Muddy Creek control structures such as dams and interceptor canals should be explored.

The local response to the Muddy Creek erosion problem and recommendations of consulting and government agencies resulted in the hiring of a Project Coordinator in May 1980, and formation of the "Muddy Creek Special Water Quality Project."

Agency Response

Prior to the hiring of a Project Coordinator, a Muddy Creek Executive Board was formed. Its membership included two ASCS committeemen from Cascade and Teton Counties, respectively; four supervisors from the Cascade and Teton County Conservation Districts (two respectively); a member of the Muddy Creek Landowners Association, and a project area irrigator, (who had non-voting association.) This board hired and directed the responsibilities of the Project Coordinator.

Meetings were held when necessary to review Project progress, recommend actions to be taken by the Coordinator, and be informed by state and federal representatives of program and funding availability.

The responsibilities of the Project Coordinator were to:

1. Research and seek federal and state funding assistance;

2. Initiate and coordinate the activities of appropriate state and federal agencies;

3. Implement specific programs aimed at on-farm water management;

4. Promote the Project through meetings with civic, state, and federal organizations;

5. Draft legislation; and

6. Prepare reports as needed summarizing Project activities.

Throughout the formative and funding stages of the project, appropriate members of the Task Force were assembled and informed of progress or asked for advice on funding or technical aspects of implementation.

In addition to the Task Force, a Technical Field Committee was formed in July 1980 to develop strategies for implementing solutions to the erosion problems. Its members were the Soil Conservation Service, Bureau of Reclamation, Environmental Protection Agency, and the U.S. Army Corps of Engineers. The Project Coordinator also, served on the committee.

The report, "Muddy Creek Erosion Problem - A Coordinated Strategy for Federal Action," summarized their findings:

> After considering five alternative plans to improve on-farm irrigation water management, the committee recommended increasing the area under sprinkler irrigation from the present 5,000 acres to 25,000 acres. Optimum surface irrigation systems with automation would be installed on the remainder of the 51,000-acre area. Installing the recommended plan will reduce the flow in Muddy Creek by approximately 61 percent and contribute to a 35 percent crop yield increase. The estimated cost of implementing the recommended on-farm plan is $19 million or $372 per acre (1980 dollars.)

One of the benefits as well as responsibilities of the Coordinator's position has been promotion of the Project in Washington, D.C.. The purpose of three trips there was to seek federal support and funding, primarily from the ASCS, SCS, BR and EPA. Our first contact was a visit to Montana's congressmen, Senator's John Melcher and Max Baucus, and Representative Ron Marlenee. They were supportive of our efforts, often writing letters of Project support and arranging meetings with Interior and Agriculture Department agencies. Program objectives and funding requests were discussed with directors or important officials of the key agencies noted above. In addition, state-federal program liaisons stationed in Washington, D.C. were also asked to schedule meetings for us.

The results of this have been an increased awareness of Montana's agricultural problems and needs at the federal level. Our understanding of the federal funding systems and available programs, enhanced participation of this project in agricultural and water resource funding programs.

The state agencies with long-term program involvement in this project have been the Montana Departments of Health and Environmental Sciences (DHES), and Natural Resources and Conservation (DNRC). In Great Falls, the Area Chamber of Commerce and the Westside Flood Control District gave support to our goal of reducing Sun River sediment originating from Muddy Creek.

Project Funding

Project Issues -

The Muddy Creek Project attempted to focus on several interrelated issues in its goal of sediment reduction. A unified solution is complex. It involves irrigation canal water transport and farm delivery system modifications, changes in the timing and systems of field water application, the need for surplus water diversion and/or storage, and finally, Muddy Creek streambank and channel structures. These have been studied but not all addressed.

This is seen as an environmental as well as water management problem. Because of its scope, a variety of funding sources were explored to maintain interest in finding solutions. Attempts to define the source of the problem seemed to point the finger at irrigators as culprits in over-application of water and the Greenfields Irrigation District as mismanaging its canal delivery system. The District responds to requests for water needs from over 400 farmers and delivers water in a largely, unlined canal network of over 300 miles length. The volumes of water simply needed to transport sufficient "heads" to irrigators and canal design result in unused discharges into the wasteways entering Muddy Creek. In addition, existing field conditions and long irrigation runs require large water volumes and intense management by irrigators to prevent even nominal surface and groundwater losses.

The Greenfields Irrigation District has almost completed an $8.3 million canal updating project. Under a Rehabilitation and Betterment loan from the Bureau of Reclamation, 78 miles of delivery canals have been concrete lined, 34 miles replaced with pipe, and 20 miles of open ditches consolidated, enlarged or relocated. These improvements started in 1978 and will be completed in 1985. An earlier calculated water delivery efficiency showed

that of all the water released from Pishkun Reservoir (about 20 miles west of Fairfield), only 46 percent of it actually reached farmers' fields. As a result of this improvement program, 59 percent is now delivered to irrigated fields--a marked improvement.

Because of the number of issues involved, objectivity in applying for funding is important in a successful application. Effective solutions have been defined to bring the Creek's flows and sediment in line with acceptable reductions.

Funding Sources -

Approximately ten funding sources have been applied to and provided money for administration and implementation of the Project. A few observations may be instructive in respect to the feasibility of applying to certain organizations for funding and their institutional framework.

The first obvious source of funding for a project of this magnitude is federal. Because agricultural practices lie at the root of the problem, the United States Department of Agriculture (USDA) agencies such as the SCS and ASCS are logical sources of funding.

One of the more successful irrigation improvement programs resulted from increasing the cost-share money already available under a well-known federal program by supplementing it with funds from a regional aid organization--the Old West Regional Commission. (This commission, however, is now non-existent.)

The structural measures deemed necessary such as canal diversions, dams, riprap, and rock drops are in the realm of the United States Department of Interior's Bureau of Reclamation (BR), or the United States Army Corps of Engineers (CE). In the case of the BR, an inordinate amount of time and pressure was needed to make them respond even in a superficial way. Under their guidelines, the water problem must lie within a BR project and its boundaries to be eligible for aid. Congressional pressure is also a necessary ingredient. Bureau of Reclamation funding can also be channeled through the Montana Department of Natural Resources and Conservation (DNRC), since these agencies are directed to cooperate in many projects involving water works. Although the Corps did complete an earlier study on costs of Muddy Creek channel control, they claimed the BR had jurisdiction in this area.

In environmental issues, the EPA has had programs aimed at protecting and improving water quality. Their statewide 208 planning process and now,

205j program, provides funds for non-point source pollution, considered largely agricultural in nature. In the past, the emphasis was on an inventory and identification of these sources. Bills presently before Congress will hopefully address impementation. Funds from these two programs are (in some cases,) passed-through to state health departments who administer the money under thier own guidelines.

State programs, while limited financially, are close at hand, fairly direct in their requirements, and provide funds in a timely manner. The agencies responsible for water quality and management improvements are the DHES and DNRC, respectively. The DHES has been a valuable and consistent source of administrative and water quality funding. Program implementation funding is available from the DNRC. Their Renewable Resource Development (RRD) and Water Development Program (WDP) grants can apply to a variety of projects, but are seriously limited by policy to a $100,000 maximum grant/ loan award, and are provided for a two-year period. Project funding requirements in excess of this limit must depend on multiple sources or federal programs. Because of funding limits and lack of authority to provide funds beyond a two-year period, state programs aren't designed to aid projects of any appreciable size or impact. These must be part of a department's own internal planning process and so receive multi-year funding assurance. Because of this, many medium and large-scale projects not obviously tied to federal benefit and cost guidelines find themselves outside any viable funding source.

The last area of funding often explored is that of private foundations. In this case, such terms as "agriculture," "conservation," "environment," and "wildlife" may be selected to look under for foundation listings. A good place to start is The Foundation Directory, The Foundation Grants Index, and The Corporate Fund Raising Directory. Many foundations lack the resources to fund any major projects. The largest single factor frustrating the efforts at trying to find implementation funding is the practice (or policy) of almost exclusive foundation giving to recognized institutions. Much of the grants are awarded to higher learning centers, especially universities, where research and education, and computer programs reach many people. In reality, only a handful of foundations could be considered worth the effort to contact. Many foundations are set-up to deal with a limited geographical area. Some are multi-state, statewide, and some only serve a specific area within a state. Remember, foundations want results and want an

institution with a proven track record. Some operate with only several thousand yearly, and a few actually grant from $15-$25 million annually! A list of those contacted for this project were: 1. W. K. Kellogg Foundation, Michigan; 2. The Rockerfeller Foundation, New York; 3. The Ford Foundation, New York; 4. Agway Foundation, New York; 5. George Frederick Jewett Foundation, California; and 6. Northwest Area Foundation, Minnesota.

It is the Coordinator's opinion that, unless the project is educational in nature, or experimental and innovative, the chances of foundation grant success are very small. Another possibility may be to gain the interest of a university and have them request foundation funding.

The following is a listing of funding sources and amounts granted to this project:

	PROGRAM DESCRIPTION (Chronological)	AMOUNT/YEAR
1.	208 Water Quality Program (DHES) This was a "208" grant and was used for the Coordinator's salary, benefits, room rent, and transportation.	$ 95,000 FY-80-83
2.	Water Quality Monitoring - Old West Regional Commission The OWRC funded the bi-weekly sampling of 25 wells on the Fairfield Bench for a year. These domestic wells were sampled for nitrates and pesticides. Several of the wells exceeded the acceptable nitrate levels of 10 milligrams/liter.	$ 9,800 1980
3.	Supplemental Grant - Old West Regional Commission These funds were used to augment the existing ASCS/ACP cost-share program for land leveling, ditch lining, and sprinkler water lines. Up to $3,500 in OWRC funds were matched with $3,500 in ACP funds to stimulate interest in these improvements. Thus, an irrigator could receive up to $7,000 combined grant funds, not to exceed 50 percent of the total costs. More than 100 farmers used this program.	$200,000 1980

PROGRAM DESCRIPTION	AMOUNT/YEAR
4. Agricultural Conservation Program (ACP) (ASCS) This is a 75 percent cost-share grant for increasing the efficiencies of irrigation systems. This includes land leveling, ditch lining, and buried sprinkler lines. The amount of the grant, or farmer payment for each practice, however, can't exceed $3,500 per fiscal year. A farmer may sign-up for a Long-Term Agreement (LTA) for three to five years for several such practices and receive a total of $10,500-$17,500 in federal assistance. Each practice must be completed in one year (such as land leveling) to receive up to the $3,500.	$1,016,000 FY-80-84
5. Renewable Resources Development (RRD) Program (DNRC) This provided grant/loans for any project conserving a renewable resource. The grant was used for 1. monitoring canal flows and drawing-up an irrigation water budget; 2. monitoring irrigation water use; 3. irrigation scheduling; 4. development and use of new automated flood systems; and 5. a study of major water diversion and dam alternatives. One federal and three state agencies as well as the Greenfields Irrigation District completed these responsibilities.	$300,000 FY-81-82

	PROGRAM DESCRIPTION	AMOUNT/YEAR
6.	Water Development Program (WDP (DNRC) The guidelines for this and the RRD program were very similar. This program emphasized water development. Our program consisted of a 50 percent cost-share fund resulting in approximately half of the system costs being paid by the farmer. This was exclusively for any automated flood irrigation system, and included land leveling, ditch lining, automated gate turnouts and portable field check dams. Automation consisted of clock timers or field moisture sensors that opened the gates of each field panel. Field ditch automated check dams are portable and use clock timers. To date ten systems have been installed and use has shown positive results in water and labor savings.	$100,000 FY-83-85
7.	Conservation District Administrative Funds (DNRC) This was used for one month of the Project Coordinator's salary and benefits.	$ 2,500 Oct. 1983
8.	Administrative Funding (BR) The Bureau of Reclamation provided the Project with administrative funds for the Coordinator's position for a four month period.	$ 10,000 1983-84
9.	Small Watershed Protection Program (SCS) This is a 50 percent cost-share program to draft irrigation management plans for farmers and pay 30-50 percent of the costs for sprinkler or automated flood irrigation systems. This is limited to a 10,000-acre area of the northeast Fairfield Bench, where about 40 farmers live. Because of hilly topography and porous soils, sprinklers are better suited	$874,000 1984-94

PROGRAM DESCRIPTION	AMOUNT/YEAR
to this area. About $600,000 is for cost-share assistance, the remainder is for SCS administration. This is a ten year program, but most of the funds may be used in the first three years to five years.	
10. 205J Program (DHES) This proceeded the "208" program and has been used to fund small watershed and stream improvement programs. These and the (above)? 208? funds are actually EPA pass-through monies for state agency dispersal. This grant was used for a base line Muddy Creek inventory and defined the type and amount of streambank loss and channel conditions. Approximately 35 miles of the Creek were walked for a detailed bank survey, and a report was completed describing its condition. A (this) historical report of the Project was also completed, and cooperators having automated flood irrigation systems were interviewed to document water and labor savings. A Project Reference File of total program information was also established.	$ 7,700 Nov 84-Jan 85

Legislative Response

The most challenging aspect of a project that has no identified, continued operating funding source is promotion. Although identified as a state priority area, no state agency has "adopted" this as a department responsibility. Although the technology developed for water conservation under this project can be applied statewide, the Project's limited size and high cost creates a minimum level of acceptance among legislators. State department directors are reluctant to embrace such a project because it parallels some of their efforts and competes for limited state funding. Finally, each legislative session can't commit proceding? session members to funding amounts beyond a biennial time period. Succeeding?

If the project is of regional impact, the first step is to contact appropriate congressional legislators for a link to federal program sources. A program summary, including goals and objectives, should be sent to these congressmen and identified federal program administrators. A follow-up trip to Washington, D.C. shows a significant level of community interest. Visits with state legislators several months prior to legislative sessions with a brief one page Fact Sheet helps "individualize" the project as do area tours sponsored by an appropriate local governmental agency, (such as a conservation district.)

During the legislative session active lobbying and mustering of local forces for hearing sessions are essential ingredients, even if the project has been included as part of a more comprehensive state package bill. Choosing the right bill sponsor as someone who is well known, and respected, takes much of the work of lobbying off the director's shoulders. For example, during the 1982-83 biennium, Representative Rex Manual, Teton County, supported the Project, and introduced a bill for a cost-share program for the Muddy Creek Project. (It did not, however, get out of committee.) Also, then-Representative Ted Neuman, Cascade County, and Chairman of the Muddy Creek Landowners Association, supported the Project at the state level as did the Governor's Aid, Larry Fasbender, Jr., Fort Shaw farmer, (and now DNRC Director.)

Prepared legislative statements from project cooperators provide tangible evidence of need and success. During the 1983 Legislative session, 10 to 15 irrigators drove down to the hearings in Helena more than once to testify and show project support. In one case, this meant leaving at 6:00 A.M. to participate.

Lastly, integrating the objectives and goals of the project with that of state department priorities minimizes isolating a project, and aids in gaining departmental and legislative support.

Experience has shown that these approaches can help in successful project campaigning. This "visibility" should come through sponsors and cooperators and not as a director or coordinator-initiated scheme.

Project Accomplishments

Setting Project boundaries accomplished two things: It required an agreement among several different interests that these boundaries were reasonable limits in defining a problem area; and that financial aid would be provided inside those lines and not outside. In 1980, the Teton County ASCS Committee raised the limit of cost-share assistance from its traditional $2,500 to $3,500 yearly for farmers within the Project Area. Within six months the rest of the County was also raised to the $3,500.

Many of the more than 400 farmers in the boundaries became aware of the special status of the Project and potential assistance available for improvements.

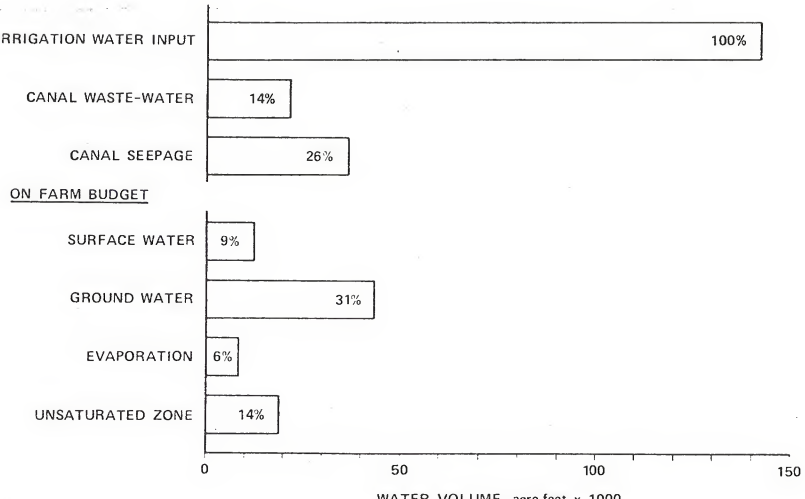
Identifying progressive farmers and consistently working with them, combined with several presentations in the area, provided a base for legislative support and tour stops. Limiting the size of the Project had the negative effect of funneling grant money to the southern areas of Teton County resulting in misunderstanding of geographical limitations on agricultural improvement aid.

Using the existing ASCS ACP cost-share program and supplementing that amount with Old West Regional Commission funds increased farmer interest in installing concrete ditches and sprinkler systems. Over 100 farmers used this combined assistance and lined over 10 miles of ditches serving 3,200 acres and installed 19 miles of sprinkler supply lines serving 5,000 acres. This alone represented an impact on over 10 percent of the entire 80,000 acre irrigated land area.

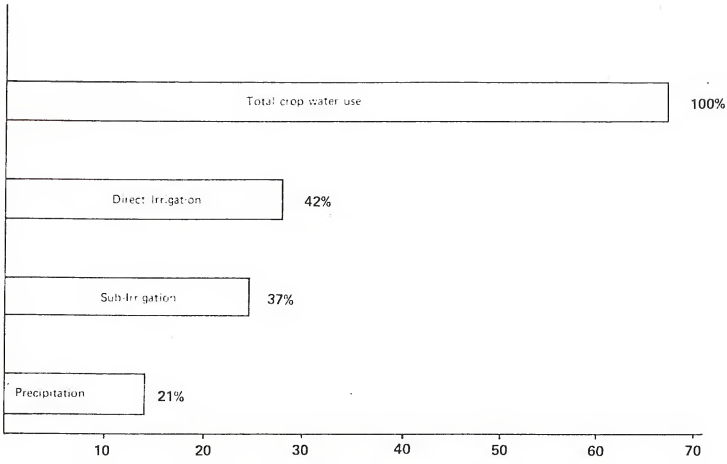
The Renewable Resource Development grant of $300,000 focused on irrigation water management. A summary of the results follow:

1. A detailed groundwater evaluation of the Irrigation District resulted in a geological investigation of the Fairfield Bench aquifer and quantification of irrigation water diversions and use. The two graphs showing irrigation and crop water use budgets are included in this report. This is the first time a complete water budget has been completed for an irrigated land area and some comments may be of interest.

a. Approximately three times the average crop water demand is delivered as irrigation water to the Bench if precipitation is included as supplying some crop water needs. This includes water to flush the network in the spring. The average water delivery (1969-83) was 3 acre/feet



Irrigation water budget for 1982.



Crop use budget for 1982

per/acre, whereas grain crop water needs vary from one acre/foot to one and a half acre/feet yearly.

b. Of the total amount of water used by the crops, approximately 31 percent of it is supplied by subsurface irrigation. Although farmers are aware that sub-irrigation affects their water management, no one knew to what extent or how much crops depended upon this unseen supply, especially if groundwater tables were to drop due to canal lining or conversion to sprinkler systems.

c. Of the total water delivered to the Bench, about 40 percent is lost to canal seepage (26 percent), and discharge from the Bench (14 percent). On the farm, 30 percent was lost to the groundwater system and 9 percent to surface runoff.

2. The Cooperative Extension Service carried out several field investigations and demonstration projects.

a. Irrigation Scheduling. For four years, the CES has gradually increased its cooperators in the timing of crop water applications from five to approximately 50. Weekly visits were made to cooperators' fields to determine crop stage and remaining soil water. Using this information and the evaporation from a water-filled washtub determined the date of the next irrigation. A survey was conducted of the cooperators to record their response in using this scheduling system. About 50 percent of the 55 cooperators responded. Ninety-five percent stated that irrigation scheduling helped in time and labor management. The same number indicated they would continue to use the soil probe and evaporation pan in irrigating. Many thought that scheduling had contributed to higher than normal yields. Many were interested in crop disease under irrigation, yield versus fertility costs, and fertilization of grain crops. Despite the initial interest in this program, only a few irrigators presently schedule irrigation sequences. The Extension Service is attempting to continue this service on a limited scale.

b. Surge Flow in Irrigation. Previous studies in Utah have shown that alternately releasing and stopping the flow of water in individual field panels during a single irrigation "set," actually uses less water than continuous flow and correspondingly loses less to deep-percolation. This intermittent, or "surge flow" concept was tried on the Bench. Two "surge gates" were installed on a cooperator's field, (Allyn Paddock's) and consisted of a water height (pressure) sensitive gate, and a weighted arm.

This arm kept the gate closed until the canal water reached a specific height and then, released the gate. When the water level dropped to several inches in the canal, the gate snapped shut. Water alternately released and stopped for one-hour intervals reached the end of the field in about the same time as continous flow. The successively longer wetted area formed a somewhat impervious surface that aided in rapid water advance and slowed down subsurface water percolation. Because of timely rains and late installation, the gates have only had fallow field trials. Some form of storage system is needed for surge-use and automation may be necessary if that doesn't exist. Field testing will begin in May 1985. This is the only known field installation in the State. Water savings of up to 50 percent are expected.

3. The Bureau of Reclamation, in a reconnaissance study, did a field survey of potential diversion and dam sites for surplus water control. Five alternatives were studied:

a. Reservoir on Muddy Creek. A dam near the Town of Power would store 14,000 acre-feet and be 80 feet high and 660 feet in length. A canal intercepting three drainways would collect and divert this water into the reservoir. Water would then be released at a controlled rate into Muddy Creek. The cost was estimated at $22 million.

b. A dam and canal on Big Coulee were considered as separate possibilities. The dam would be 85 feet high and be 1,200 feet in crest length. Estimated cost, $23 million. The canal option would parallel the natural stream and empty into the Sun River. This 11 mile canal would cost $13 million.

c. The Mill Coulee Canal would be enlarged and existing control structures replaced. Approximately 16 miles of modifications would cost $13 million.

d. A diversion canal from the main irrigation supply canal would empty surplus flows into Freezeout Lake. The Lake system would act as a surge reservoir, eventually discharging into the Teton River. Costs range from $5-9 million.

e. A series of 35 rock-drops, or low-elevation dams, would be constructed in the actively eroding Muddy Creek reaches. This would decrease its gradient and minimize erosive surges. This would cost $9 million.

The dam on Muddy Creek was selected by the Bureau of Reclamation because of its effectiveness in reducing sediment. Its design life is 100 years.

The SCS Small Watershed Protection Program started 1984. It is in effect on 10,000 acres in the extreme northeast area of the Fairfield Bench. Of this, 4,780 acres are irrigated. There are 37 farmers having an average farm size of 270 acres. The watershed plan calls for installation of both sprinklers and automated flood systems on 70 percent of the irrigated land area. Water efficiency is calculated to increase from 29 percent to 50 percent and crop yields increase by 20 percent. Comprehensive water management will be required for maximizing water use and irrigation scheduling is included. The SCS will pay 50 percent of the actual costs for systems but not exceed $100,000 for any one farm. More efficient use of water means less water in Muddy Creek although we don't know exactly how much. About 2,000 acre-feet of water savings is calculated to result from complete installation of planned systems. Nine cooperators now have sprinkler and flood systems installed, and approximately six irrigators are requesting new systems.

A Water Development Program (WDP) grant request of $100,000 for the 1983-84 biennium has been used for irrigation automation. Previously, a small part of the RRD grant was set aside for experimental flood systems. These first systems were: head ditch turnouts of PVC pipe using hypalon tubes to hold and release field water, and a portable check dam that dropped open, releasing water down ditch. Both used clock timers which were pre-set to trip these units.

With the grant of the WDP funds, this was expanded to refine these units and develop more efficient water sensing and release systems. In developing or searching for new ideas, Dr. Allen Humpherys of the Snake River Project in Idaho has been very supportive in supplying ideas for new release systems. He is a specialist in flood irrigation and has developed water release systems for graded border and furrow fields. The objectives of the WDP grant were to:

1. Research and develop new irrigation control units;
2. Provide cost-share incentives to irrigators to apply these units; and
3. Promote and install these on a number of cooperators' fields as demonstration units and monitor their use.

A simple, effective drop-closed head ditch check dam and drop-open gate was developed for use in concrete ditches. These were largely planned by the SCS and fabricated by Meyer Ditcher Company, Fairfield, Montana. Unlike many western states, Montana is a surplus water state and the large volumes of water used in irrigation required redesign of traditional water release systems. Check dams are trapezoidal to fit ditch dimensions and rotate in one inch diameter pipe rings. They are held open by a rope attached to the respective gate turnout system and drop close as the field gate drops open. The gate is hinged to a heavy metal frame placed in the concrete and is sealed with a hypalon fabric that acts as a water chute into each panel. This 18" x 36" gate is held closed by a rotating lever held up by the same rope system that released the gate and dam. These are more easily installed than the PVC pipe turnouts and require less maintenance. Cost for the dam is $112 and gate is $125.

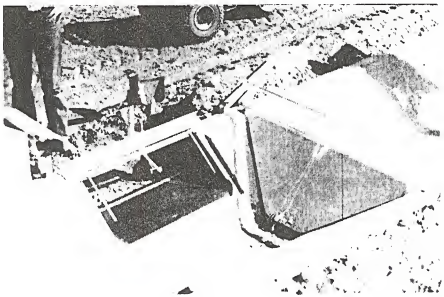


PHOTO: Newly concrete-lined head ditch with closed check dam and opened turnout gate. Note, rope system and hypalon seals on dam and gate face. Cooperator Allyn Paddock's field.

The portable field check dam is also trapezoidal and uses a 3/4" tubular metal frame. The shoulder extensions support the dam on ditch banks and the three gate sections open, released by a hinged angle iron bar held closed by a timer. The system weighs approximately 35 pounds. Again, hypalon is used as an apron seal against the ditch banks. The cost of fabricating this is $150. Using several of these in succession in field laterals can save substantial amounts of water, particularly during night sets.

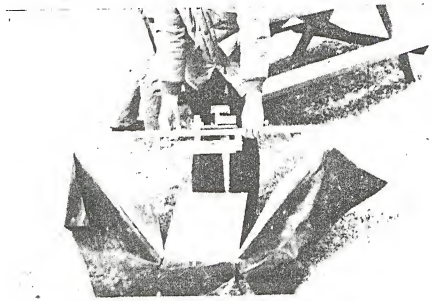


PHOTO: Portable field check dam showing shoulder extension on tubing, hypalon seals, three opening gate doors, and clock release.

The most sophisticated, and ultimately most effective system developed in automating water flow was the water-sensing sending and receiving units. The Agricultural Extension Service of Montana State University developed a downfield water sensor that sends a radio-signal to a head gate release receivor. When irrigation water advances downfield to the sensor, a transmitter sends a 10 second coded signal to a designated receivor at the next field turnout gate. The receivor activates a solenoid that trips a lever, opening the gate and closing the check dam. The WDP program provided five sensor-receivor units for each field so that 10 to 15 hours of automation were possible. These were then moved to the next five panels. Both of these units are presently costing $600 as a pair. (See photo on next page.)

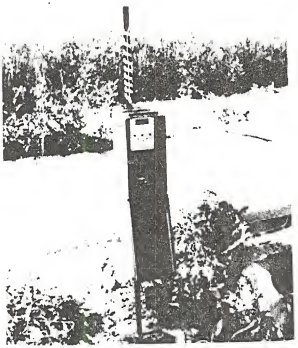


PHOTO: Head ditch receivor unit showing upper antenna and box containing clock timer and battery unit. Companion sensor system sits downfield. Roy Konen's field.

The systems just described were used in conjunction with land leveling, if needed, and concrete head ditch lining. These two practices, when combined with automated dams and gates can maximize water application efficiency. Costs for all of these were well established for the 10 systems installed, including field check dams. The costs for installing, or carrying out these field modifications can be given for an average field size of 40 acres having a quarter-mile head ditch and quarter-mile irrigation run.

1. Field Leveling. Leveling (70¢ a yard x 350 yards/acre) = $245 an acre. Thus, 40 acres of leveling could cost $10,000.

2. Concrete Lining. Preparation of a ditch pad and excavation equals $1.75/foot and the pouring equals $6.00/foot, or a combined $7.75/foot. Thus, a quarter-mile, or 1,300 feet costs $10,100.

3. Head Ditch Water Control. As already described, check dams cost $112 and its companion gates, $125. Assuming an average panel width of 60 feet, 21 gates, or turnouts would be needed on a quarter-mile ditch. Since the check dams are portable, five are required. So then, 21 x $125 = $2,625, and 5 x $560 or total cost of $3,185.

4. Timers. If timers are used, five would be needed for five checks and these are also portable. The timers presently suggested are $65 each including shipping (based on current U.S. rate), and can be purchased from STAFIX, Limited, New Zealand. (The following photo, however, shows a Japanese-made timer purchased from Irrigation Systems of West Colorado at $75 each not including shipping).

PHOTO: Coret timer with nylon release arm and rope trip system. Note rope holding up gate release arm. Cooperator Arnold Siegle's field.

5. Sensor-Receivors. For field automation, five of these units are needed; one sensor and one receivor as a unit for each panel. At $600 each unit = $3,000.

6. Field Check Dams. To effectively automate field lateral diversions, five dams should be used, providing 10-15 hours of automation. Timers are needed for each one, so that each dam and timer costs $225. Thus, five cost = $1,125.

Integrated Field Improvements. If all of these modifications were installed, this "average" field, using timers would have a total improvement cost of $23,600.

If sensors were used, the increased cost would be $26,300. Improvement costs per acre would vary from $590 to $655 an acre. Actual costs have run much lower, however, because of lower, earlier sensor costs ($310 each) and lack of the need of leveling on many fields. For the eight full systems installed (not field dams), costs ranged from $177 to $374 an acre.

Field Evaluation

These systems have only been in place one season and more objective assessments should be made in the two coming growing seasons. Generally, our problems have been with timers and sensor-receivor units.

Because of the recent research into flood automation using timers, no products we were aware of had a proven track record. The Coret timer previously illustrated was purchased through Irrigation Systems of West Colorado, and are the ones presently used on the new systems. These have been inconsistent in field use and consequently, are no longer recommended. A different timer from New Zealand will be used and is consistent in operation. The sensor-receivors represent high technology, and need someone to continue assisting irrigators on their operation. They went through several stages of improvement in their development, but still present problems in field use. The radio-coded signal will trip head gates at a half-mile distance, but power lines are found to interfere and deflect these signals. Unlike the sensor which automatically compensates for differing field conditions, timers must be preset for optimum water coverage by adjusting for varying water advance rates.

Those using the sensor units were Roy Konen, Randy Brady, Allyn Paddock, and Dale Beck. All cooperators found the sensors reliable. In one case, none failed to trip the gates in 54 sets. The challenge was finding the optimum downfield location that minimized tailwater losses from residual water after closing that field's water supply. The two problems in some systems were field border dikes that were too low and overtopped with water, and consistent release of gates. The rope-release system often hung-up on guide loops. In one case, because of uneven ditch dimensions, check dams that rotate in the one-inch pipe rings weren't properly sealing. This was modified so that this hinge system provided more freedom of movement to conform to ditch sides. Although five sensors were supplied to each cooperator, in two cases three were used because of longer set times and the difficulty of handling more than three in carrying them across field panels. When the field was dry, they were hard to push into the soil. In one case, sensor signals were absorbed by power lines along the head ditch, and timers were substituted. One irrigator claimed that he applied approximately four inches of water during each of three irrigations and calculated he saved about 30 percent in water and in labor. If four inches were applied each time, the system would be very efficient in application and equal or surpass that of sprinklers. Once farmers know the effects of flood automation and savings, the adoption of gates, timers or sensors should be widespread.

Several cooperators used the wind-up clock timers for head ditch automation. They were Arnold Siegle, Harry Freeman, and Evan Vervick. The Coret timers were well tested prior to field use, but didn't always release for some cooperators. Arnold Siegle has had excellent success with these timers. In 51 sets for three irrigation sequences, only one failed to trip. As a result of pre-timing his sets, tailwater runoff was greatly reduced and a single irrigation sequence was reduced from three to a little over two days. This amounts to about two-and-a-half million gallons in water savings. This means that less water was lost to the system as groundwater and therefore, lower fertilizer losses. With a lot of care, the clock-wind timers seem to function well. Because of the friction lever, it is difficult to select the exact time. Due to their inconsistency, they are being replaced by a New Zealand-built timer using a motor driven cam-release lever. One irrigator did not use his timers, but said the gates and dams worked well manually.

Two cooperators are using field check dams with wind-up timers. Dale Beck and Paul Brunner have five each and find their advantages in being used for night sets. Often such "sets" down field ditches are each planned for

between one and three hours. Both cooperators think these portable dams are useful, but too heavy. They are constructed of steel and weigh about 35 pounds. Carrying two to the next field ditch is cumberson and aluminum should be used, although costs would almost double. One or two per cooperator would be a good "introductory" offer to automation.

Generally, the head ditch gates and dams and field check dam, seemed to work and hold promise of greater future use for flood irrigation. Presently, additional purchases of sensor-receivor units will not be recommended. They need refinements and someone to be on-site to instruct farmers in their use. The person who helped develop and introduce them, Mr. Larry King, is no longer employed in Montana, and the technician, John Rompel, who designed the system works part-time for the University system. Some other agency would need to carry out refinements and be responsible for their operation. Major savings in labor, irrigation water, and fertilizer should not be difficult to document with consistent use of these systems. With such use and proven benefits, a cost-share program shouldn't be necessary in a few years.

Project Future

The Muddy Creek Project was originally envisioned as a multi-year irrigation and stream improvement program. It was also assumed that existing federal programs would grant long-term funding for innovative approaches to solving surplus water losses. Funding limitations and program withdrawals at the federal level forced us to rely more completely on state funding. Because of biennial grant limits, repeatedly returning to state legislative sessions and the same fund sources mitigated against long-term state support.

One of the state funding sources that may be modified is the Resource Indemnity Trust Fund (RITF), which soon may be termed the "Legacy Fund," if approved by the 1985 Legislature. Now under legislative administration, it is proposed to be put under DNRC administration, hence the name change. If this happens, the potential of narrow guidelines and a limit on project fund requests may also make this a relatively useless funding source for major projects. During the past several legislative sessions, this revenue source has been almost exclusively legislated for use by state government, although it is legally available to all recognized local governmental entities. It has been used to fund a variety of resource improvement projects, but is funded by a mineral producers' tax. It may now be envisioned only as an extraction impact mitigating fund. Those agencies with agricultural

interests hope that "conservation" can be included in guidelines under the Legacy Fund. It may then become useful for projects such as Muddy Creek.

An application presently before the SCS is requesting additional Small Watershed Protection funding (as previously mentioned.) This would extend the existing Small Watershed Program and cover the entire Fairfield Bench. In the light of present federal budget cuts, it is doubtful if this will be successful. Additionally, many farmers lack even 50 percent of the cost of installing sprinkler, or automated flood systems.

One final program that could be implemented would be the "beaver alternative." Despite the four years of work in the Project, nothing has been done to alter the streambank conditions originally giving the Project its formation. Those living along the Creek are justifiably disillusioned about visual progress in arresting streambank losses. The major structural solutions proposed by the Bureau of Reclamation range from $6-$20 million.

At very little cost, the states of Wyoming, Colorado, and Alabama have successfully used beaver in reclaiming ravaged streams and mined areas. Basically, a proposal for Muddy Creek consists of:

1. Selection of candidate stream areas and farmer fencing agreements.

2. Willow plantings in fenced riparian areas.

3. Beaver transported to these fenced areas and hauling of a food and dam-building supply to encourage dam building.

This could be a two-year program and would cost a fraction of any Reclamation project. A beaver dam could cost $3,000 as opposed to $250,000 for a single Bureau rock-drop dam! If successful, the dams would be functioning in two years and begin to create stable streambank riparian vegetation zones.

Ideally, such a program would be in concert with a complete riparian protection plan. Most of the Creek's stream corridor should be fenced off about 50 to 100 feet on either side of its banks, and cropping and grazing excluded. This would minimize bank instability and allow for natural plant succession and some sloughing.

When the Bureau of Reclamation orginally constructed the irrigation district water delivery system, they didn't envision or plan for the volume of wastewater discharging into Muddy Creek. Because of this, it

could be considered an "unfinished" Bureau project. However, trying to get them to admit this and then express an interest in becoming a partner in this integrated solution has been unsuccessful. This is a Bureau and not an irrigation district responsibility. Bureau support, both technically and financially, is essential in a final solution. Until some form of structural measures in drainways and Muddy Creek are undertaken, erosion and sedimentation above acceptable levels will continue.

As long as there are any irrigation improvements being carried out on the Bench above and beyond traditional SCS and ASCS assistance programs, the Muddy Creek Executive Board will continue to exist as a board. If state funding programs permit three to five year project implementative projects, such as Muddy Creek, it could again be promoted by a Coordinator.

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MUDDY CREEK PROJECT

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